

# Comment on “Spreading widths of giant resonances in spherical nuclei: damped transient response” by Severyukhin et al. [arXiv:1703.05710].

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(Dated: March 29, 2017)

We argue whether physics of universal approach of Severyukhin et al. [arXiv:1703.05710] is approved.

A universal approach (UA) to describe spreading width of giant resonances in atomic nuclei has been offered recently in Ref. [1]. We discuss below its physical content.

One reads in Summary that the authors “suggest the way to describe spreading widths of GRs by including the coupling between one-phonon and two-phonon states.”[1]. This idea already belongs to well-established knowledge; it is employed by many nuclear models during almost half a century. Accordingly, the above-mentioned suggestion does not sound timely as original one.

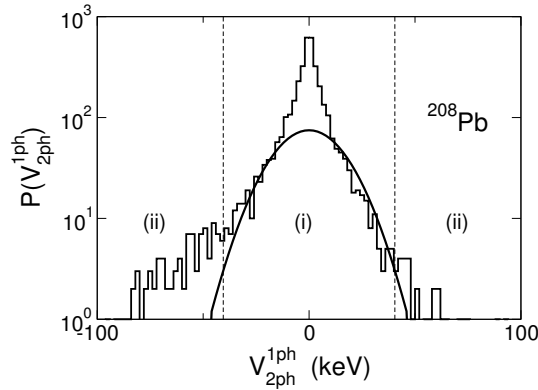


FIG. 1: Distribution of coupling matrix elements  $V_{2ph}^{1ph}$  between the one- and two-phonon configurations in the QPM calculation for the isoscalar giant quadrupole resonance in  $^{208}\text{Pb}$ . The solid line denotes a Gaussian distribution expected for a chaotic system with a width in accordance with the QPM results. Taken from Ref. [2].

An original suggestion of Severyukhin et al. is to generate the coupling matrix elements  $V_{2ph}^{1ph}$  between one-phonon (1ph) and two-phonon (2ph) states “by means of the random distribution”[1] in Gaussian form.

The matrix elements  $V_{2ph}^{1ph}$  have been already analysed, e.g., in Refs. [2, 3] within the quasiparticle phonon model (QPM) [4]: They have been “divided into two subspaces: (i) a large subspace with  $V_{2ph}^{1ph}$  following the Gaussian distribution (plus overshoot small matrix elements) and (ii) a small subspace with large  $V_{2ph}^{1ph}$  values above the Gaussian tails.”[2] (see Fig. 1 taken from Ref. [2]). It has been demonstrated that “the fragmentation is dominated by the collective mechanism”[2], i.e. determined by the matrix elements from the group (ii).

The UA suggests to neglect the most important matrix elements from the group (ii) in favour of less important ones from the group (i) (without overshooting small matrix elements). As a result, calculations in Ref. [1] confirm[\*] observation in Ref. [2] and at the same time, are in obvious conflict with conclusion in Ref. [1] that the UA “enables to describe gross structure of the spreading widths of the considered giant resonances.”[1].

To conclude: Any interaction between doorway and background states yields fragmentation pattern; any distribution has its width. But this alone is not sufficient to claim that the width predicted by the UA describes the physical width of giant resonances. The UA appears to miss the main contribution to the width formation.

Support by the DFG (Contract No. SFB 1245) is acknowledged.[+]

- [1] A.P. Severyukhin et al., arXiv:1703.05710.
- [2] A. Shevchenko et al., Phys. Rev. Lett. **93**, 122501 (2004).
- [3] A. Shevchenko et al., Phys. Rev. C **79**, 044305 (2009).
- [4] V.G. Soloviev, *Theory of Atomic Nuclei: Quasiparticles and Phonons* (Institute of Physics, Bristol and Philadelphia, 1992).

[\*] The widths in *Random* are substantially smaller as compared to the ones of *PPC* for the ISGMR and ISGQR (see Table I in Ref. [1]).[\*\*]

[\*\*] The IVGDR width in Ref. [1] is determined by the Landau damping (compare to *RPA* in the same Table I).

[+] Having no discussions on the topic with the authors of [1], I cannot accept their thanks “for useful discussions”.